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Small Mesh Codend Covers

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Small Mesh Codend Covers

P A M Stewart
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Introduction

Small mesh codend covers are commonly used to obtain fish population estimates in codend mesh selection experiments (Beverton and Holt, 1957; Pope *et al.*, 1975). The mesh size of a cover must be considerably less than that of the codend to retain small fish and is typically 30 mm. The use of such covers has been criticised on the grounds that the small mesh netting may obstruct the codend meshes or restrict water flow through the codend, thus limiting the opportunities for fish to escape (Davis, 1934; Pope *et al.*, 1975). In either event, the presence of a cover may alter the selectivity of the codend it is being used to measure. Experiments have been performed to investigate the masking effects of small mesh covers in selectivity experiments (Clark, 1963). This work suggested that covers may be obstructive but that if used carefully can give valid data. Much of the published work on codend mesh selectivity was done with two-panel demersal trawls of low headline height. The codends of many of these nets were fitted with bottom-side chafers, which prevented fish escape. The small-mesh cover was fitted on the upper side of the codend. Totally enclosing covers have also been used and were recommended by Pope *et al.* (1975) as potentially less obstructive. A recent report by Sakhno and Sadokhin (1982) showed that totally enclosing and top-side only covers produced different results, the former giving more reliable data. Masking of the codend meshes during covered codend selectivity experiments is thus a topic of continuing concern to fisheries scientists, whose data may be used to justify minimum mesh size regulations.

A codend is not a uniform cylindrical shape when towed. Codends on nets have been found to have a bulbous shape as shown in Plate I. Water pressure on the accumulated fish stretches the netting. Over most of the length of the codend the meshes are elongated and nearly closed. Fish escape mainly from the front of the bulbous section where the meshes are open. Before direct observation was possible, Beverton (1963) suspected that this took place and investigated fish escape routes by using a cover divided into four sections. Most fish were found in the rear section, some in the fore section and very few in the middle sections. Direct observation has now shown that Beverton's results were due to the distorted, bulbous shape of the codend.

Codends are usually attached to a net with an extension piece. On a commercial net the purpose of this is to hinder escape during hauling by holding the catch far from the trawl mouth. In some current demersal trawls the extension can be longer than 15 m. Observation has shown that the meshes in an extension piece are stretched and closed, preventing the escape of all but very small fish. An extension piece becomes a long tube of closed mesh netting between the net and codend.

Plate I **A typical codend with the netting stretched into a bulbous shape**

The Marine Laboratory is currently investigating the selectivity of square mesh codends, mostly by the covered codend technique (Robertson, 1983). The covers being used in these experiments are of small diamond mesh netting and of the totally enclosing type. Unlike a diamond mesh codend, a square mesh codend is not distorted by water pressure; the netting retains its cylindrical shape and the meshes are fully open. A diamond small mesh cover, which will be distorted in use, may cause more obstruction on a square mesh codend than on a diamond mesh codend. Information was needed on the shapes taken up by these covers to assess the likelihood of obstruction of the codend meshes. Observations were made at sea on the experimental codends and covers rigged in various ways. A square mesh cover was also tested. This report describes the observations made and includes a representative selection of photographs. A video film has been compiled and is available from the Marine Laboratory.

Materials and Methods

The Marine Laboratory has developed a Remote Controlled Towed Vehicle (RCTV) for making underwater TV observations on fishing gears (Wardle, 1983). It was used during a cruise on FRV "Clupea" to observe small mesh covers. Video tape records were made during each haul and still photographs (see Plates I-VIII) taken whenever possible.

Fishing took place off the east coast of Orkney in depths of about 70 to 90 m. Towing speed was kept constant around 3 knots, measured with a towed log. The gear used was the Marine Laboratory four-panel trawl (Galbraith, 1983). This gear was chosen as it has a steeply tapered funnel and it was planned to attach covers directly to the funnel to increase the mouth diameter. The main species caught and shown in Plates I-VIII were herring, *Clupea harengus* (L.), haddock, *Melanogrammus aeglefinus* (L.), whiting, *Merlangius merlangus* (L.), and the common dab, *Limanda limanda* (L.).

Observations were made on 80 mm nominal mesh size codends of diamond and square mesh green polyethylene netting and 30 mm nominal mesh size covers of black polyethylene netting. Details of the construction of the codends, covers and the green polyethylene extension piece used are given in Table I. The stretched lengths and widths of the covers were 1.5 times those of the codends.

Table I.

Construction of the Codends, Covers and Extension Piece.
(S – single twine; D – double twine; B – braided; T – twisted)

Nominal mesh size (mm)	Type	Nominal twine runnage (R tex)	Twine	No. of meshes round	No. of meshes long	Stretched length (m)
80	Diamond codend	4310	S/B	120	75	6
80	Square codend	4310	D/B	120	75	6
30	Diamond cover	1724	S/T	480	300	9
30	Square cover	1724	S/T	480	300	9
90	Diamond extension piece	4310	S/B	120	50	4.5

The test codends and covers were rigged in three different ways. These are depicted in Figure 1 and called rigs a, b and c. Rig a depicts a typical experimental arrangement: the codend was attached to the net with an extension piece and the cover was fixed to the join of the codend and extension. In rigs b and c, the codend was attached directly to the funnel of the net. The cover was attached to the same place as the codend in rig b and 2 m ahead of it in rig c.

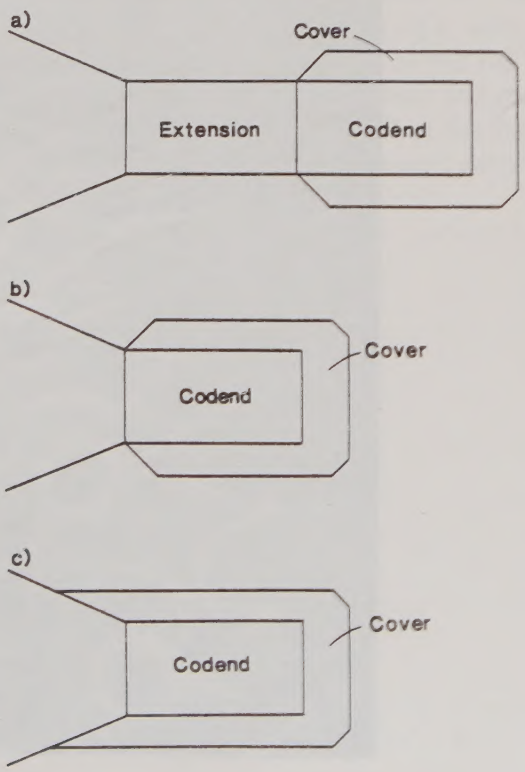

Figure 1 Schematic diagram showing the rigging of codends and covers.

Three illustrations show how the codends and covers were attached. Plate II shows the typical appearance of the codend and extension join with a diamond mesh codend and cover (rig a). Plate III illustrates the attachment of a square mesh codend and cover in rig b, and Plate IV illustrates the attachment of a diamond mesh cover in rig c.

Plate II Attachment of a diamond mesh codend and cover to the extension piece (rig a) showing elongation of meshes.

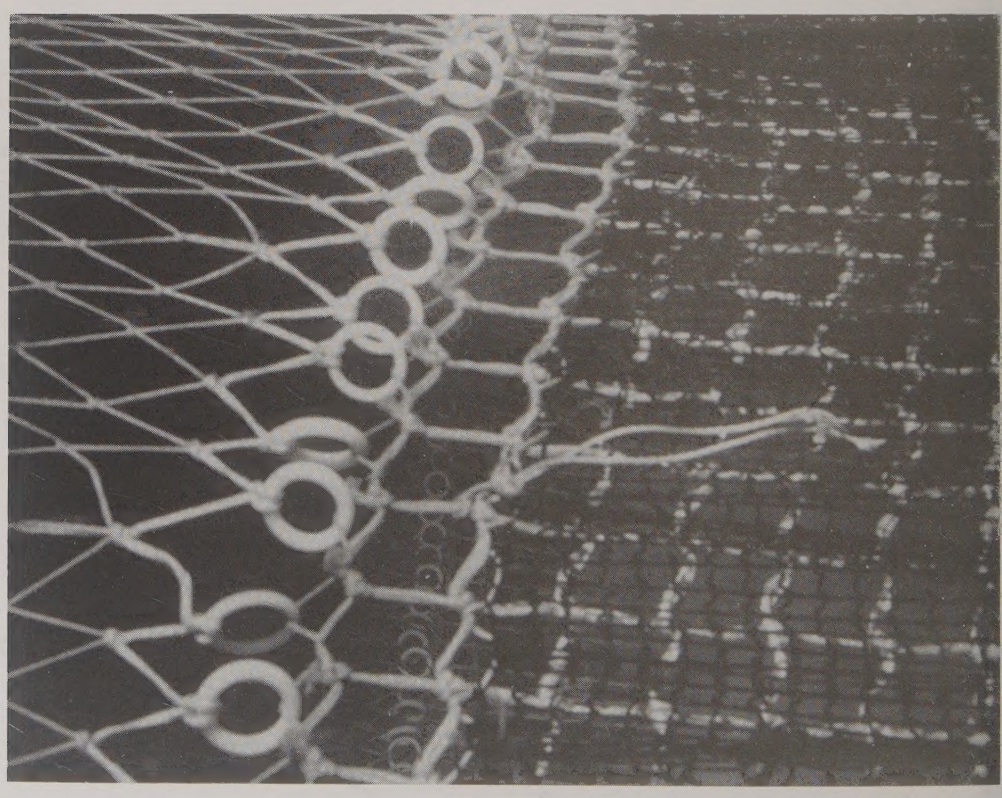

Plate III Attachment of a square mesh codend and cover to the funnel of the net (rig b).

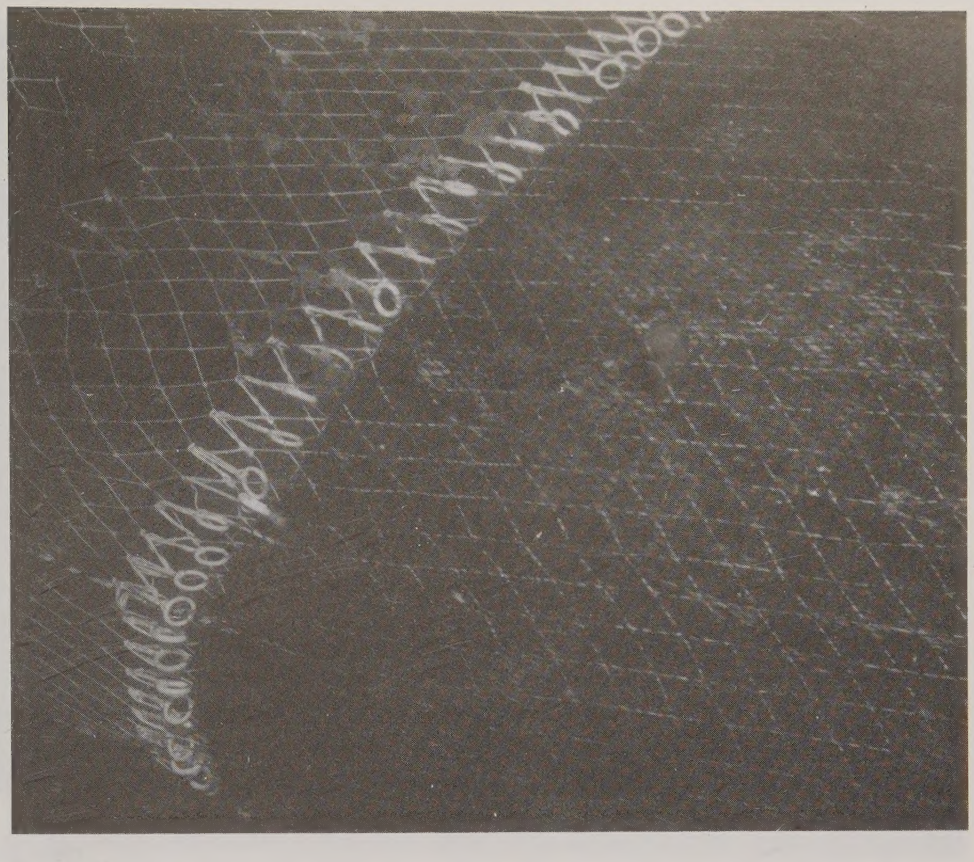

Plate IV **Attachment of a diamond mesh cover to the funnel of the net, 2 m ahead of the codend and funnel join (rig c).**

Observations on Covers

A representative set of illustrations (Plates V-VIII) demonstrates how small mesh covers perform. It is not an exhaustive collection showing every type of codend and cover with all three rigs, but a selection chosen to show the clearance between various codends and covers.

Diamond Mesh Covers

Plates V and VI are of the diamond mesh cover on the diamond mesh codend. Plates V(i) and (ii) were taken using rig a, with an extension piece. Whilst few good photographs were obtained of this rig, it can be seen that there is a very large clearance between the cover and codend. Plate VI(i) is of the centre part of the codend and Plate VI(ii) of the forward part using rig b, showing that very good clearance can be achieved with this rig.

Plate V(i)

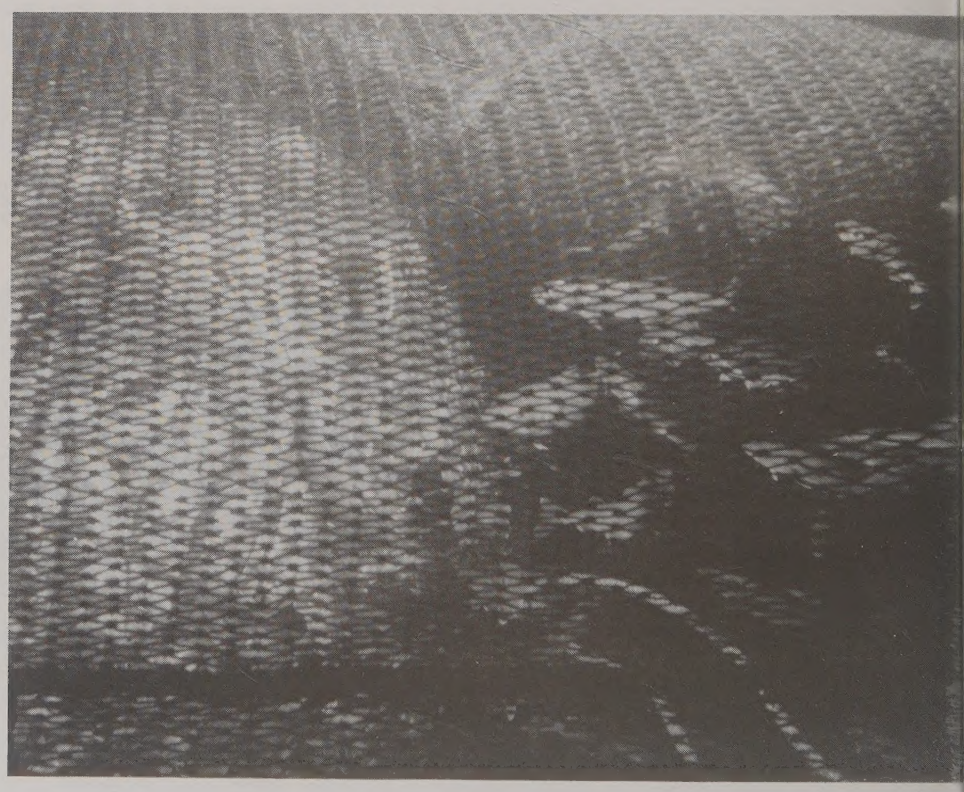

Plate V(ii)

A diamond mesh cover on a diamond mesh codend (rig a), showing the extent of the unobstructed region around the codend.

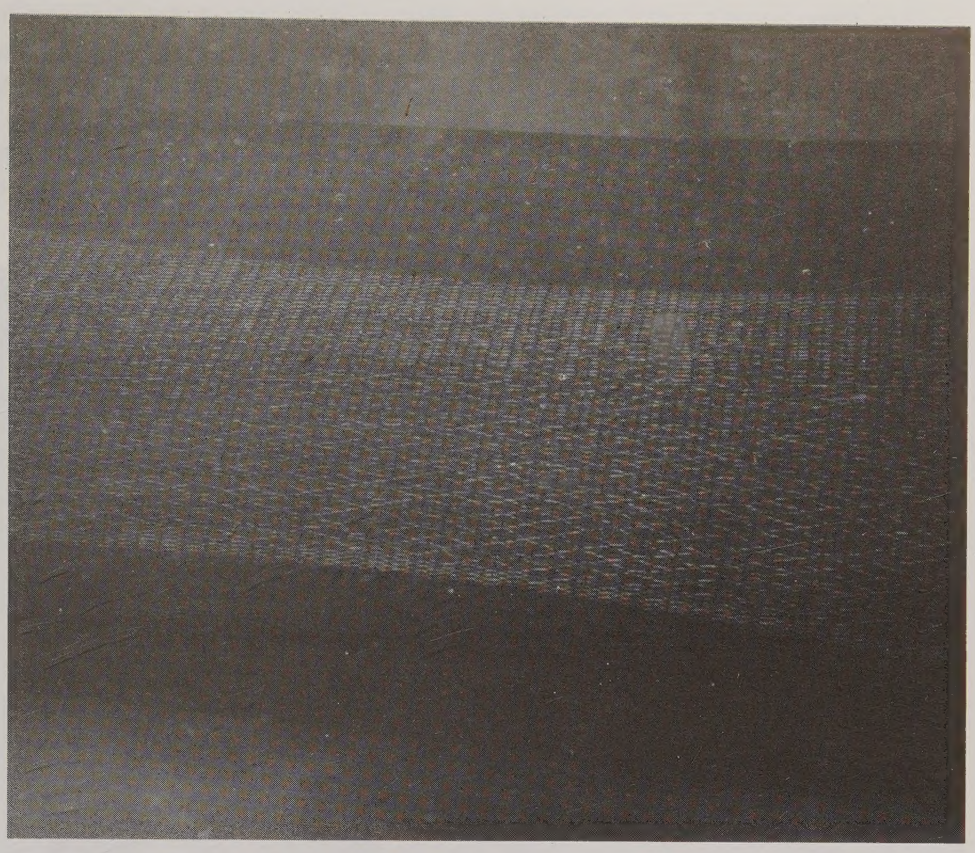

Plate VI(i)

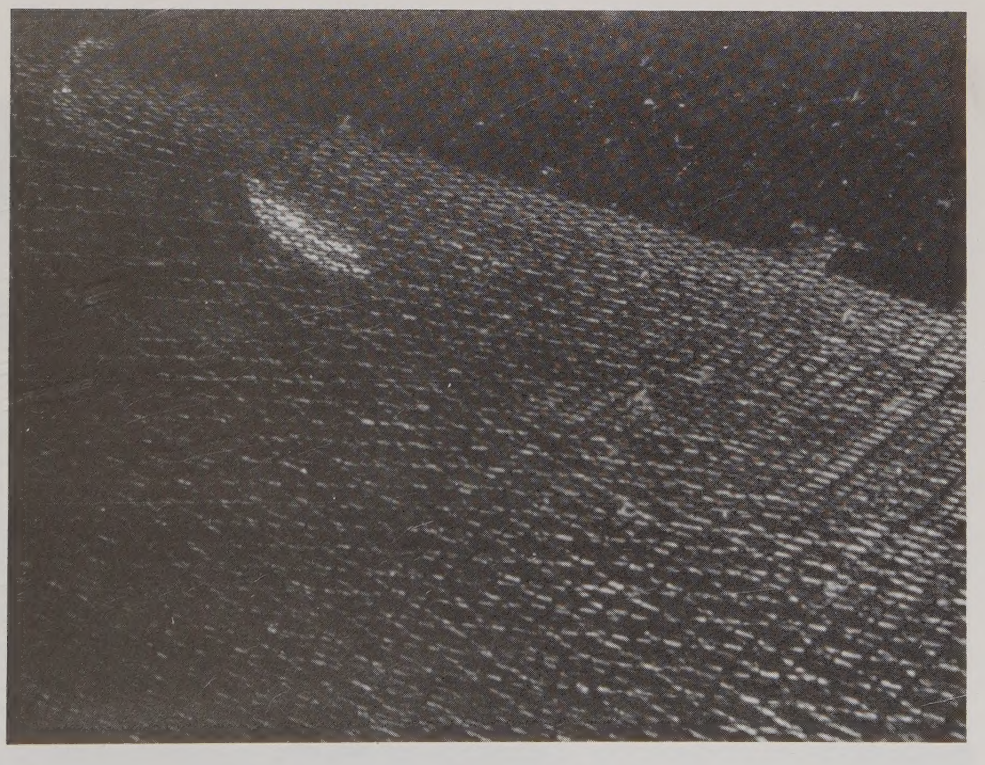

Plate VI(ii)
A diamond mesh cover on a diamond mesh codend (rig b);
(i) centre section, (ii) fore section.

Plates VII(i) and (ii) are of the diamond mesh cover on the square mesh codend with rig c. The leading edge of the cover is forward of the codend join, leaving much less clearance astern of the codend. The square mesh codend is fully open, without any lengthwise stretching of the meshes, whilst the diamond mesh cover is slightly bulbous. Nevertheless, there is adequate clearance between codend and cover for the fish to escape.

Plate VII(i)

Plate VII(ii)
A diamond mesh cover on a square mesh codend (rig c), showing reduced clearance.

Square Mesh Covers

Plate VIII(i) is of a square mesh cover on a square mesh codend using rig b. The square mesh cover is also fully open and is clear of the codend. Plate VIII(ii) is of the same items using rig c. This arrangement gave the greatest observed separation between a codend and cover.

Plate VIII(i)

Plate VIII(ii)

A square mesh cover on a square mesh codend;
(i) rig b, (ii) rig c, showing very large clearance.

Discussion

This investigation has shown that it is possible to rig small mesh covers on codends without physically obstructing the codend meshes. Fish were seen to escape readily from the codends. Totally enclosing small mesh covers of 1.5 times the length and width of the codend can now be used with some confidence that they are not likely to prevent the escape of fish. Use of a cover smaller in length and width than this constitutes an unnecessary risk. Furthermore, it has been shown that, on a steeply tapered net, a cover can be rigged to be very well clear of the codend.

The square mesh cover appears to have ideal characteristics in that it streams with maximum cross-sectional area. Before such covers could be adopted, it would be necessary to determine the square mesh size equivalent to 30 mm diamond mesh to obtain the same population sample. In many cases, however, it is probably not necessary to use such a small mesh size. For example, to obtain the 50% length for haddock in an 80 mm mesh size trawl codend (at least 23 cm) it is not necessary to retain fish smaller than about 18 cm (Holden, 1971).

The four-panel trawl has a steeper taper in the funnel than many commercial nets. When an extension is used, however, the cross-sectional area of the front end of the codend is comparable to that in a typical commercial net. If the use of a steeply tapered net with rig c is proposed to estimate codend selectivity, then the codend should be long enough to ensure that the meshes in its central section are well stretched and closed. In other words, the gear should be designed to simulate conditions in a commercial net. This is of great importance when the selectivity data are to be used as a basis for selecting minimum mesh sizes in a fisheries management scheme. Even if the mouth opening and rigging are identical to those in commercial nets, there may be a significantly greater loss of small fish through the more steeply tapered funnel of the four-panel trawl.

Acknowledgements

We thank the officers and crew of FRV "Clupea" whose cooperation enabled these observations to be made, and Mr R D Galbraith for providing two of the photographs.

Summary

In codend mesh selection experiments, small mesh codend covers are used to obtain stock population estimates. The cover mesh size is usually about 30 mm. There is concern that this small mesh netting may obstruct the codend meshes, preventing the escape of small fish and so altering the selectivity. To investigate this problem, underwater television was used to make direct observations on covered codends. Both diamond and square mesh covers and codends were used, rigged with different mouth diameters. Observations were recorded by still photography and on video-tape. A representative selection of illustrations is given. It appears that a cover which is 1.5 times the length and width of a codend is unlikely to obstruct the codend meshes.

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